PATENT ABSTRACTS OF JAPAN

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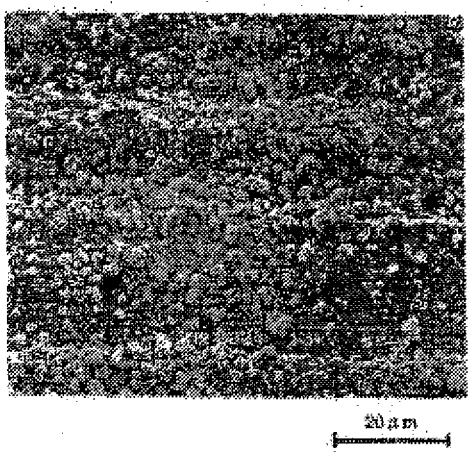
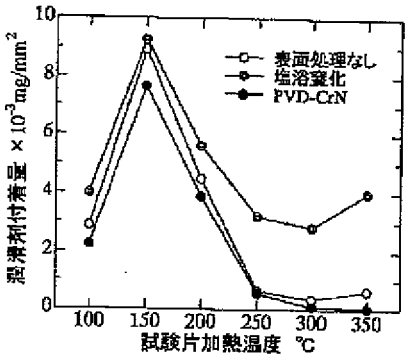
(54) COATING TOOL FOR WARM AND HOT WORKING HAVING EXCELLENT LUBRICANT ADHESION AND WEAR RESISTANCE

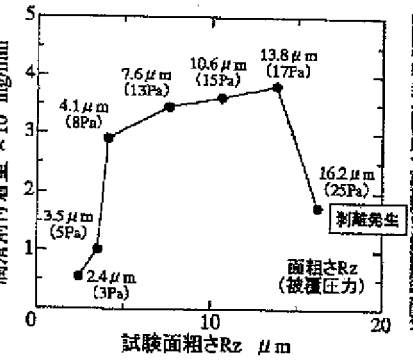
(57)Abstract:
PROBLEM TO BE SOLVED: To provide a coating tool for warm and hot working which has excellent seizure resistance and wear resistance.
SOLUTION: In the tool for warm and hot working, hot die steel or high speed steel is used as a base material, and at least the working face is provided with a coating layer. The outermost surface layer of the coating layer consists of an (a) layer having surface roughness Rz of 4 to 15 μm. Also, a (b) layer consisting of one or more kinds of the nitrides, carbides and carbonitrides essentially consisting of one or more kinds of metallic elements selected from Ti, V, Cr, Al and Si lies directly on the base material. Desirably, the (a) layer essentially consists of one or more kinds of metallic elements selected from Ti, V, Cr, Al, Si and Cu, and whose layer thickness is controlled to 2 to 15 μm. Further, the coating layer is desirably coated by a physical vapor deposition method. Also, it is desirable that, in the coated base material, its hardness in a depth of 25 μm from the outermost surface of the base material is higher by ≥0.2 in 200 HV than the hardness in a depth of 500 μm from the outermost surface of the base material.



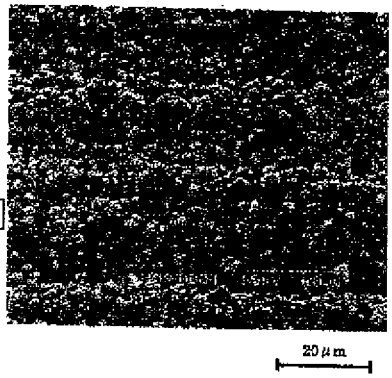
【図１】


表面処理なし
塩浴窒化
PVD-CrN
潤滑剤付着量 ×10⁻³mg/mm²
試験片加熱温度 ℃

【図２】


4.1μm (8Pa)
7.6μm (13Pa)
10.6μm (15Pa)
13.8μm (17Pa)
16.2μm (25Pa)
3.5μm (5Pa)
2.4μm (3Pa)
剥離発生
面粗さRz (被覆圧力)
潤滑剤付着量 ×10⁻³mg/mm²
試験面粗さRz μm

【図３】


20μm

CLAIMS

[Claim(s)]
[Claim 1]To a work plane, are die steel between heat, or high-speed steel a tool for processing between warm temperature with an enveloping layer used as base metal at least, and the outermost layer of this enveloping layer, Surface roughness is a layer which is Rz:4-15micrometer, and And Ti, V, Cr, A covering tool for processing between warm temperature excellent in lubricant adhesion and abrasion resistance to which b layer which one sort or two sorts or more of metallic elements chosen from aluminum and Si become from one or more sorts of a subject's nitride, carbide, and carbon nitride is characterized by being in right above [base-metal].
[Claim 2]A covering tool for processing between warm temperature where this a layer made a subject one sort or two sorts or more of metallic elements of Ti, V, Cr, aluminum, Si, and Cu and which was excellent in lubricant adhesion according to claim 1 and abrasion resistance, wherein thickness is 2-15 micrometers.

[Claim 3]A covering tool for processing between warm temperature excellent in lubricant adhesion according to claim 1 or 2 and abrasion resistance covering an enveloping layer with physical vapor deposition.
[Claim 4]A covering tool for processing between warm temperature hardness in a depth of 25 micrometers excelled [covering tool] in lubricant adhesion according to any one of claims 1 to 3 and abrasion resistance being [0.2 or more 200HV] high compared with hardness in a depth of 500 micrometers from the base-metal outermost surface from the coated base material outermost surface.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to covering tools for processing between warm temperature, such as a forge public-funds type used in the environment accompanied by the slide of metal between ** or between heat.
[0002]
[Description of the Prior Art]Conventionally, steel for the metallic molds between heat called SKD61 and SKT4 which are mainly specified to JIS is widely used for the tool for processing between warm temperature.
SKD7 whose high temperature strength is higher than these, SKD8, high speed tool steel, or these improvement steel is used for the use of which especially endurance is required.

[0003]For example, in a warm temperature forge public-funds type (it is hereafter described as a metallic mold), While holding the toughness of a metallic mold to the demand of the improvement of processing efficiency in in recent years, highly-precise-izing of processed products, and near-net-shape-izing, For the purpose of raising the abrasion resistance of a metallic mold work plane, seizing resistance, and heat-crack-proof nature, the nitriding treatment by plasma process, a salt bath process, Gas Act, etc. and the coat by physical vapor deposition (it is hereafter described as PVD), such as the arc ion plating method, are combined with nitriding treatment, and have come to be applied.
[0004]In order to raise the adhesion of a mold matrix and a PVD coat in JP,H11-92909,A, As pretreatment of covering by PVD(s), such as CrN or TiAlN, adjustment of the surface roughness of the coated base material by diamond paste etc., application of vacuum nitriding processing, and washing by an electrolytic decomposition process are proposed. Concomitant use of TiN by nitriding treatment and PVD, CrN, and TiCrN is proposed by JP,H11-152583,A the heat-crack-proof nature of a metallic mold, and for the purpose of oxidation-resistant improvement.
[0005]
[Problem to be solved by the invention]However, the effect by the proposal of JP,H11-92909,A and JP,H11-152583,A, As compared with a tool, it is improvement in a life of about 20 to 30 percent conventionally, and an improvement of a fast tool life cannot be attained and cannot fully be satisfied to demands, such as improvement in processing efficiency, highly-precise-izing of processed products, and near-net-shape-izing.
[0006]Since a product configuration becomes complicated [especially near-net-shape-izing of processed products], at the time of processing, the load stress to a metallic mold work plane not only also becomes large, but the material-flow speed of a work material changes greatly with places of a metallic mold. That is, in the early stages of a forge when the skin temperature of a metallic mold is unstable, the skin temperature of the metallic mold by sliding generation of heat with a work material will also change greatly with places.
[0007]Generally, in the forge between warm temperature, although lubricant is sprayed for every forge, lubricant has the characteristic of becoming the easiest to adhere in a certain arbitrary mold surface temperature. For this reason, the coating weight of lubricant also changes with the places of a metallic mold a lot, and the place where a proper quantity of lubricant adheres, and the place not adhering produce that the skin temperature of a metallic mold changes greatly with places. Naturally, in the part to which the coating weight of lubricant falls, it becomes easy to generate printing by a work material, galling, etc. at an early stage.
[0008]Generating of such printing, galling, etc. is an interface of a metallic mold work plane and a work

material, it will use excessive frictional force and remarkable frictional heat generates it. As a result, in a metallic mold material surface part, since base metal becomes soft extremely with heat, a coat will exfoliate easily and the abrasion resistance of a metallic mold will fall extremely. Environment where may become an elevated temperature, so that the above-mentioned frictional heat exceeds a transformation point (700-900 **) of metallic mold material itself depending on a product configuration, and a metallic mold is exposed will become very severe.

[0009]Now a PVD coat proposed as an object for the metallic molds between warm temperature, Since an improvement was made improvement in adhesion of a mold matrix and a coat in a subject, when it was used for the lubricant adhesion of point ** in an environment which variation produces, it was printed at an early stage and galling etc. occurred, and also while fully demonstrating the effect, there was a problem of there being nothing and exfoliating.

[0010]The purpose of this invention is to provide a covering tool for processing between warm temperature which is excellent in seizing resistance which solved the above problems, and abrasion resistance.

[0011]

[Means for solving problem]this invention person performed examination detailed about influence of a presentation of a PVD coat exerted on the adhesion of lubricant in a tool for processing between warm temperature and seizing resistance, and resistance to scuffing, a layer system, and a film formation condition.

[0012]As a result, apply the layer which specified granularity in the specific value to the outermost layer, and right above [base-metal], It found out that lubricant adhesion and seizing resistance very good as a tool for processing between warm temperature were acquired because one sort or two sorts or more of metallic elements chosen from Ti, V, Cr, aluminum, and Si form one or more sorts of a subject's nitride, carbide, and carbon nitride. For example in the hot-forging public-funds type, local printing in early stages of a forge was fully controlled by this result, and it checked that a life improves remarkably as a hot-forging metallic mold.

[0013]Namely, to a work plane, the 1st invention of this invention is die steel between heat, or high-speed steel a tool for processing between warm temperature with an enveloping layer used as base metal at least, and the outermost layer of this enveloping layer, Surface roughness is a layer which is Rz:4-15micrometer, and And Ti, V, Cr, b layer which one sort or two sorts or more of metallic elements chosen from aluminum and Si become from one or more sorts of a subject's nitride, carbide, and carbon nitride is the covering tool for processing between warm temperature excellent in the lubricant adhesion and abrasion resistance in right above [base-metal].

[0014]As for a layer of this invention, it is desirable to make one sort or two sorts or more of metallic elements of Ti, V, Cr, aluminum, Si, and Cu into a subject, and for thickness to be 2-15 micrometers. As for the above-mentioned enveloping layer, having been covered with physical vapor deposition is desirable. As for a coated base material, it is desirable for the hardness in a depth of 25 micrometers to be [0.2 or more 200HV] high compared with the hardness in a depth of 500 micrometers from the base-metal outermost surface from the base-metal outermost surface.

[0015]

[Invention embodiment] First, the covering tool for processing between warm temperature of this invention applies the material which is excellent in warm strength as a base metal with which the enveloping layer is formed. What is necessary is just to be the steel stock conventionally applied, for example as a tool between that warm temperature as this material, and they may be die steel between heat and high-speed steel which are specified to JIS, and those improvement steel. The constituent features is first described in detail about a layer of a description among a claim.

[0016]Since hardness is remarkably high compared with a nitrated case, application of the coat by PVD, such as TiN, CrN, and TiAlN, has spread the cutting tool among subjects. For example, although the hardness of a nitrated case is based also on the presentation of processed material, to being 1000 - 1100HV, compare with 2000 - 2200HV in TiN, and it compares with 1800 - 2000HV in CrN, and compares with a nitrated case with 2400 - 2700HV in TiAlN, and more than twice [about] as many hardness as this is obtained. For this reason, originally abrasion resistance must be excellent in the direction of the coat by PVD.

[0017]Then, as a result of an inventor's repeating examination variously about the characteristic needed for warm temperature processing public-funds type an operating environment and a surface treatment, it checked that the PVD coat applied conventionally is extremely inferior in the adhesion of lubricant which is the very important characteristic in a warm temperature processing public-funds type compared with a nitrated case.

[0018]Drawing 1 heats the test piece which performed the surface treatment beforehand at the arbitrary temperature of 100-350 **, The weight per unit area of lubricant adhering to the test piece surface at the time of spraying the white system lubricant (Daido chemistry incorporated company make hot AKUARUBU #300TK) solution adjusted to 10% of concentration for 2 seconds by the distance of 470 mm and spray volume 2.0 ml/s is shown. At this time, what does not perform a surface treatment, and the thing which covered CrN by salt-bath-nitriding material and PVD (the arc ion plating method) were used for the test piece.

[0019]According to this result, about salt-bath-nitriding material, that tendency becomes remarkable at the specimen cooking temperature at 250-350 ** which has much coating weight of lubricant compared with a non-treatment material especially to which this lubricant becomes difficult to adhere. At this time, it is a result not more than it, and, as for the lubricant adhesion of CrN covering material, it turns out that the lubricant adhesion of a PVD coat is equivalent to a non-treatment material, or clearly inferior compared with other surface treatments. In the case where the point of being inferior to the lubricant adhesion of such a PVD coat is the complicated form where skin temperature changes especially with places of a metallic mold in a actual warm temperature processing public-funds type, since it appeared notably, the part where lubricant does not adhere easily locally occurred, and it was guessed that printing and galling were induced.

[0020]Then, as a result of performing detailed observation of a lubricant adhesion condition about the test piece after the above-mentioned examination, signs that lubricant used minute unevenness on the surface of a test piece as the core, and it had solidified were accepted, and it was checked like the thing with this detailed coagulation unit that the coating weight of lubricant increases.

[0021]Then, the film formation condition of PVD was controlled, and the surface roughness of the enveloping layer produced a variously different test piece, and investigated surface surface roughness and the relation of lubricant coating weight with the same test method. At this time, specimen cooking temperature was set as 300 ** to which lubricant does not adhere easily.

[0022]For covering by PVD, membranes were formed using the target made from pure Cr by choosing the pressure of 3-25 Pa among the covering material temperature of 500 **, and argon atmosphere. Surface roughness was controlled by the pressure under membrane formation. Bias voltage was set to -100V about for 5 minutes in early stages of membrane formation, and it was made into 0V for 30 minutes of the second half. The surface roughness of the test piece covering surface was measured about a field 5 mm in length using scanning laser microscope OLS1000 by Olympus optical incorporated company.

[0023]Although the result was shown in drawing 2, it turned out that the coating weight of lubricant increases greatly bordering on near 4 micrometer by the surface roughness Rz (JIS-B-0601:10-point average of roughness height), and it is improved the salt-bath-nitriding material shown by drawing 1, and more than equivalent. When the surface roughness Rz was set to not less than 16 micrometers, exfoliation produced the PVD coat at the time immediately after membrane formation, and it was admitted that application in a real mold was difficult.

[0024]In the early stages of a forge when the skin temperature of a metallic mold is unstable, a layers of this invention are the roles with main raising the coating weight of lubricant, and the existence is very important. In order to demonstrate this effect, not less than 4 micrometers is required of the surface roughness Rz, but if 15 micrometers is exceeded, the adhesion of a coat will fall extremely. Therefore, a layer of this invention shall be 4-15 micrometers by the surface roughness Rz. Although a layer in particular of this invention does not establish regulation of its presentation and composition, it is desirable by the following Reasons to make one sort or two sorts or more of metallic elements of Ti, V, Cr, aluminum, Si, and Cu into a subject.

[0025]Also in the above-mentioned presentation, about Ti, V, Cr, aluminum, and Si. In the covering tool for processing between warm temperature of this invention, one sort or two sorts or more of metallic elements used as following Mandatory chosen as right above [coated base material] from Ti, V, Cr, aluminum, and Si are connected with forming b layer which consists of one or more sorts of a subject's nitride, carbide, and carbon nitride. For example, that the metallic elements which constitute a layer and b layer differ when sputtering process and the arc ion plating method are applied also in PVD needs to prepare the metal target in which kinds differ similarly. This is not desirable in order for the kind of expensive target to increase and to make the cost of membrane formation increase as a result.

[0026]However, it is for the drying time of lubricant being rash and the coating weight of lubricant increasing remarkably by applying Cu whose thermal conductivity are an exception and is high about the Reason for mentioning Cu to a composing element with desirable a layer. Compared with other metal, such as Ti, V, Cr, aluminum, and Si, as for this, the effect is greatest, and it is effective under the environment where lubricant hardly adheres. As for a layer of this invention, since it is above, it is desirable to make

one sort or two sorts or more of metallic elements of Ti, V, Cr, aluminum, Si, and Cu into a subject.
[0027]About considering it as the subject, in the sum total of the element seed chosen, for example from the above, more than 50 (atomic %). although what is necessary is to just be referred to as more than 70 (atomic %) and also 90 (atomic %) in total if selection of Cu which can expect especially an effect also takes an example (the parenchyma 100 (atomic %) is included), it is as above-mentioned that what is necessary is to just be determined about this on balance with b layer described behind on the membrane formation cost reduction.
[0028]As for a layer of this invention, it is desirable for the thickness to be 2-15 micrometers. When the load at the time of processing is very high, it may die out that thickness is less than 2 micrometers at an early stage, and it may be ineffective. Conversely, when membranes are formed exceeding 15 micrometers, it is because it may exfoliate at an early stage depending on a film formation condition. Therefore, as for the thickness of a layer of this invention, it is desirable that it is 2-15 micrometers.
[0029]a layer of this invention raises the adhesion of lubricant by roughening the surface roughness moderately, and prevents printing. However, it is [that seizing-resistant improvement is only applied by the subject and], and the abrasion resistance as a warm temperature processing public-funds type is not enough. Therefore, it is required for one sort or two sorts or more of metallic elements chosen from Ti, V, Cr, aluminum, and Si to form b layer which consists of one or more sorts of a subject's nitride, carbide, and carbon nitride right above [base-metal].
[0030]The case where the number of metallic elements [layer / of this invention / b / in / for example / a nitride], such as TiN, CrN, VN, and CrN, is one, and the case where metallic elements, such as TiVN, TiAlN, TiSiN, CrSiN, CrAlN, and TiAlSiN, are two or more kinds are mentioned here. In the case where stress is [in / the form of a metallic mold is very complicated and / heights] very easy to be concentrated. TiN whose remaining stress is comparatively small and which is excellent in adhesion also in the above-mentioned nitride, Application of coats, such as CrN, VN, and TiVN, is preferred, forging temperature is high, and when a coat is asked for oxidation resistance, the coat containing aluminum, such as TiAlN, TiSiN, CrAlN, and CrSiN, and Si is desirable.
[0031]Although the above mentioned the nitride as an example, Also about carbide and carbon nitride, are the same effect and Ti, V, Cr, accepting ** and necessity which make selection from aluminum and Si a subject (100% of parenchyma is included by atomic % of only a metallic element) -- the metallic element of IVa, Va, and a VIa group, B, etc. -- atomic % of only a metallic element -- 30% or less -- it may add in very small quantities 10% or less. The nitride of a different presentation, carbide, and two or more sorts of carbon nitride may be chosen, and it may apply as a multilayer film.
[0032]. As mentioned above, a covering tool for processing between warm temperature of this invention uses die steel between heat, or high-speed steel as base metal. At least, it is a tool for processing between warm temperature with an enveloping layer of the above-mentioned composition, and as one example desirable for acquiring the effect, b layer of this invention is formed in right above [base-metal], and a layer of this invention which serves as the outermost layer on [of b layer] this is formed in a work plane.
[0033]Although it is not limited for the coating method, if a thermal effect of a coated base material, fatigue strength of a tool, the adhesion of a coat, etc. are taken into consideration, especially a covering tool for processing between warm temperature of this invention, It is desirable that it is the physical vapor deposition which carries out the seal of approval of the Bias voltage to the coated base material side, such as the arc ion plating method can form membranes below with tempering temperature of die steel between heat or high-speed steel which is a coated base material, and compression stress remains to a coat, or sputtering process.
[0034]From the base-metal outermost surface to a coated base material of this invention having [0.2 or more 200HV] high hardness [in / for the purpose of more nearly wear-resistant improvement / a depth of the base-metal outermost surface to 25 micrometers] compared with hardness in a depth of 500 micrometers. That is, it is desirable to apply beforehand surface hardening which used diffusion called nitriding treatment, carburizing treatment, etc. as the example. Since a compound layer called a nitride layer called a white layer formed by nitriding treatment at this time and carbide layer accepted by carburization becomes the cause of reducing the adhesion of b layer, it is desirable to make it not make it form by control of a processing condition, or to remove by polish etc.
[0035]
[Working example]Next, although it explains in detail based on an embodiment, this invention cannot receive limitation according to the following embodiment, and can change it arbitrarily in the range which does not deviate from the summary of this invention, and each of they is contained in technical scope of this invention.

[0036](Embodiment 1) SKD61 specified to JIS was prepared and it refined from 1030 ** to 47HRC by annealing at 550-630 ** after oil-quenching. Then, 3 mm in thickness and one side processed into evaluation of lubricant adhesion the tabular test piece which is 30 mm.
[0037]Next, in 5% of flow rate N_2 (** H_2) atmosphere, after performing plasma nitriding processing on condition of 550 ** and 10-hour maintenance, the mirror plane was made to the test surface by polish, respectively. Hardness [in / from the surface after finishing / a depth of 25 micrometers] is confirmed about 0.2 or more 200HV hardening from the hardness in the depth of 500 micrometers in all the test pieces. And covering by PVD was performed on the conditions shown below to the base material surface after finishing.
[0038]b layer of base-metal right above with a small arc ion plating system in Ar atmosphere with a pressure of 0.5 Pa, After carrying out the seal of approval of the Bias voltage of -400V to a coated base material and performing plasma cleaning by the hot filament for 60 minutes, Using N_2 gas as the various metal targets which are the evaporation sources of a metallic component, and reactant gas, membranes were formed so that thickness might be set to 5 micrometers on the coated base material temperature of 500 **, the reagent-gas-pressure power of 3.0 Pa, and the Bias voltage of -100V.
[0039]About what covers a layer which forms the outermost layer, after covering b layer, it covered continuously. Using a target used for membrane formation of a pure Cu target or b layer as an evaporation source, at covering material temperature of 500 **, Bias voltage was set to -100V about for 5 minutes in early stages of membrane formation, and it was made into 0V for 30 next minutes, and in membrane formation of a layer, it formed membranes so that thickness of a coat might be set to 5 micrometers. At this time, in using a pure Cu target, N_2 atmosphere, When a target used for membrane formation of b layer was used, membranes were formed in Ar atmosphere, and a pressure of 15 Pa was used for covering of 3Pa, example of this invention, and comparative example No.24 at covering of comparative example No.21, No.22, and No.23.
[0040]As a conventional example, what formed TiN, CrN, and N ($Ti_{0.60}Al_{0.40}$) on the same conditions as covering of said b layer after said plasma nitriding processing was prepared.
[0041]An obtained test piece measured surface roughness about a field with a length of 3 mm of a tabular test piece test surface using scanning laser microscope OLS1000 by Olympus optical incorporated company. Then, evaluation of lubricant adhesion was carried out. Evaluation of lubricant adhesion white system lubricant (Daido chemistry incorporated company make hot AKUARUBU #300TK) solution which heated a test piece at 300 ** and was adjusted to 10% of concentration, Weight per unit area of lubricant adhering to a test piece surface at the time of spraying for 2 seconds by distance of 470 mm and spray volume 2.0 ml/s estimated.
[0042]The result of lubricant adhesion evaluation is shown with the details of the enveloping layer of each test piece in Table 1. Although there are also the formed a and a thing which the definition of b layer cannot carry out easily, the test piece which does not fill the enveloping layer composition of this invention is shown as in Table 1 for convenience, in order to make comparison with this invention intelligible.
[0043]
[Table 1]

	No.	b層	a層	表面粗さ Rz μm	潤滑剤付着性量 ×10⁻³mg/mm²
本発明例	1	$(Ti_{0.60}Al_{0.40})N$	Cu	11.5	4.05
	2	CrN	Cu	11.8	4.10
	3	TiN	Ti	10.5	3.52
	4	$(Ti_{0.80}Si_{0.20})N$	Cu	11.2	4.06
	5	$(Cr_{0.95}Si_{0.05})N$	Cu	11.3	4.07
	6	$(Ti_{0.60}Al_{0.40})N$	TiAl	10.6	3.63
	7	TiN	Cu	11.6	4.05
	8	CrN	Cr	10.7	3.87
	9	$(Ti_{0.75}V_{0.25})N$	Cu	11.1	4.03
	10	$(Ti_{0.75}V_{0.25})N$	TiV	10.9	3.82
比較例	21	TiN	Ti	2.1	0.53
	22	$(Ti_{0.60}Al_{0.40})N$	Cu	2.3	0.98
	23	CrN	Cu	2.0	0.92
	24	—	Cu	11.5	4.06
従来例	31	TiN	—	2.2	0.25
	32	CrN	—	2.1	0.36
	33	$(Ti_{0.60}Al_{0.40})N$	—	2.3	0.28

[0044]Since, as for the example of this invention, and comparative example No.24, surface roughness has satisfied the stipulated range of this invention as shown in Table 1, it turns out that the adhesion of lubricant is remarkably excellent. On the other hand, although a layer exists, since the surface roughness was what separates from the stipulated range of this invention, comparative example No.21, and 22 and 23 resulted in it being all remarkably inferior in the adhesion of lubricant. Needless to say, the lubricant adhesion of a conventional example is substantially inferior compared with the example of this invention. The above thing shows that this invention must be satisfied, in order to raise the adhesion of lubricant.
[0045]Drawing 3 is a surface SEM image of example Noof this invention.2 immediately after a layer covering, and it is admitted that the surface is covered with about 3-micrometer wen-like particle with particle diameter.
[0046]The hot-forging punch for bearing race molding which is surface coated layer composition equivalent to example Noof this invention .1 in (Embodiment 2), next Table 1, No.2, No.4, No.7, comparative example No.23, No.24, conventional example No.32, and No.33 was produced, and the life in a real metallic mold estimated.
[0047]The toughness improvement material of the high-speed steel base of the chemical entity shown in Table 2 was roughed at metallic mold approximation form, 1080 ** oil-quenching was performed, and it refined to 55HRC by 600 ** annealing. Then, it finish-machined and membrane formation by nitriding treatment and PVD was given on the respectively same conditions as Embodiment 1. It is confirmed that hardness [in / from the surface after nitriding / finishing / a depth of 25 micrometers] is hardened by 0.2 or more 200HV from the hardness in the depth of 500 micrometers.
[0048]
[Table 2]

	化学組成 /質量%								
	C	Si	Mn	Cr	W	Mo	V	Co	Fe
パンチ母材	0.50	0.15	0.45	4.20	1.50	2.00	1.20	0.75	殘

[0049]The metallic molds produced above are 130 mm in diameter, and a 300-mm-high size, and processing is performed to the point at the punch for bearing race molding. And hot-forging shaping of the SUJ2 work heated at 1070 ** was carried out using the 1000-t forging press. The life of each punch is shown in Table 3.
[0050]
[Table 3]

	No.	工具寿命 /個	寿命原因
本発明例	1	14,800	摩 耗
	2	15,400	
	4	16,300	
	7	14,300	
比 較 例	23	7,100	局部的なえぐれ
	24	4,600	摩 耗
従 来 例	32	6,800	局部的なえぐれ
	33	6,500	

[0051]Compared with the punch of a comparative example or conventional example application, the tool life of the punch which applied this invention improved more than twice. Although each punch of this invention application became a life by damage by wear, damage advanced and the punch which applied comparative example No.23 and a conventional example became a life, as it was able to scoop out locally, after generating galling at the punch tip at an early stage. As mentioned above, it was checked by applying this invention to the punch for hot forging that the life of a punch improves by leaps and bounds.
[0052]In Embodiments 1 and 2, although the case where b layer was a nitride was made into the example and shown, even if b layers are carbide or carbon nitride, and the composition that contains them further, the same effect is acquired.
[0053]
[Effect of the Invention]As stated above, seizing resistance and resistance to scuffing improve by applying the surface coated layer structure specified by this invention. As a result, it is possible to be able to attain a wear-resistant improvement as a tool for processing between warm temperature, and to raise a tool life by leaps and bounds.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]It is a figure showing the specimen cooking temperature of each surface treatment, and the relation of lubricant coating weight.
[Drawing 2]It is a figure showing the relation between the surface roughness Rz at the specimen cooking temperature at 300 **, and lubricant coating weight.
[Drawing 3]It is a surface SEM image of example Noof this invention.2, and is a microphotograph in which an example of this invention is shown.

[Translation done.]